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| AIR LIQUIDE Intellectual Property 2700 POST OAK BOULEVARD, SUITE 1800 HOUSTON, TX 77056 | | | EXAMINER KHOSRAVIANI, ARMAN | |
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/591,629

Applicant(s)

MISRA ET AL.

Examiner

ARMAN KHOSRAVIANI

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Period for Reply -- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 24 January 2008.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 19, 20 and 24-41 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 19, 20 and 24-41 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SI/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in **Graham v. John Deere Co., 383 U.S. 1, 148 USPQ 459 (1966)**, that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows: (*See MPEP Ch. 2141*)

- a. Determining the scope and contents of the prior art;
- b. Ascertaining the differences between the prior art and the claims in issue;
- c. Resolving the level of ordinary skill in the pertinent art; and
- d. Evaluating evidence of secondary considerations for indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

2. Claims 19-20, 26, 31, 33, 35-36 and 40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Colombo et al. (US 2003/0111678).

Regarding claim 19, Colombo teach (pars. 23-26, claim 7) a method for forming a MSiN dielectric film comprising the steps of: a) vaporizing a metal source (M) to form a

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vaporized metal source; b) providing a vapor phase silicon source; c) feeding a plurality of precursors to a deposition device, wherein said precursors comprise said vaporized metal source, a said silicon source, and a nitrogen source; and d) forming a dielectric film, wherein said dielectric film is formed in a single step such that the desired final film is formed absent a post deposition step, but fails to teach the temperature of the silicon source, namely, said silicon source having a vapor pressure of at least 50 torr (claim 9) at about 20°C.

Colombo teach the claimed invention except for said silicon source has a vapor pressure of at least 50 torr at about 20°C. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have an environment to maintain vapor pressure of at least 50 torr at about 20°C for use of a silicon source in a vapor phase, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

Regarding claim 20, Colombo teach (par. 9, claim 8) a method for forming a MSiO dielectric film comprising the steps of: a) vaporizing a metal source (M) to form a vaporized metal source; b) providing a vapor phase silicon source; c) feeding a plurality of precursors to a deposition device, wherein said precursors comprise said vaporized metal source, a said silicon source, and an oxygen source; and d) forming a metallic film, wherein said metallic film (metal-silicon-oxynitride layer) is formed in a single step such that the desired final film is formed absent a post deposition step, but fails to teach

the temperature of the silicon source, namely, said silicon source having a vapor pressure of at least 50 torr (claim 9) at about 20°C.

Colombo teach the claimed invention except for said silicon source has a vapor pressure of at least 50 torr at about 20°C. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have an environment to maintain vapor pressure of at least 50 torr at about 20°C for use of a silicon source in a vapor phase, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

Regarding claim 26, Colombo teach (pars. 9, 18) said oxygen source is selected from the group comprising: a) oxygen; b) nitrous oxide; c) ozone; d) disiloxane; and e) mixtures thereof.

Regarding claim 31, Colombo teach (par. 7, 9, claim 7: metal M is Hf, Zr, Ti, Nb...) the method above, wherein said metal source is an inorganic compound selected from the group consisting of: a) hafnium (Hf); b) zirconium (Zr); c) titanium (Ti); g) yttrium (Y); h) lanthanum (La); i) gadolinium (Gd); j) europium (Eu); k) praseodymium (Pr) or any another lanthanide (Ln); and l) mixtures thereof.

Regarding claim 33, Colombo teach (pars. 23-24, claim 7) said dielectric film is completed by using a chemical vapor deposition process.

Regarding claim 35, Colombo teach (pars. 23-24, claim 7 and 9) a MSiN dielectric film obtained in accordance with the above method.

Regarding claim 36, Colombo teach (pars. 9, 12, 18, claim 8 and 9) a MSiO metallic film obtained in accordance with the above method.

Regarding claim 40, Colombo teach (par. 7, 9, claims 7 and 8: metal M is Hf, Zr, Ti, Nb...) said metal source is an inorganic compound selected from the group consisting of: a) hafnium (Hf); b) zirconium (Zr); c) titanium (Ti); g) yttrium (Y); h) lanthanum (La); i) gadolinium (Gd); j) europium (Eu); k) praseodymium (Pr) or any another lanthanide (Ln); and l) mixtures thereof.

3. Claims 24, 29-30, 32, 34, 38 and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Colombo et al. (US 2003/0111678) in view of Buchanan (US 6,984,591) (of record).

Regarding claim 24, Colombo fails to teach the silicon source selected from the group comprising: a) disiloxane; b) trisilylamine; c) disilylamine; d) silylamine; e) tridisilylamine; f) aminodisilylamine; g) tetrasilyldiamine; h) disilane; i) derivatives of disilane and/or trisilane; and j) mixtures thereof.

However, Buchanan teach (Example 1 in cols. 18-19: silane, disilanes, chlorosilanes, silylamines) said silicon source is selected from the group comprising: a) disiloxane; b) trisilylamine; c) disilylamine; d) silylamine; e) tridisilylamine; f) aminodisilylamine; g) tetrasilyldiamine; h) disilane; i) derivatives of disilane and/or trisilane; and j) mixtures thereof.

Since both Buchanan and Colombo teach the method above, it would have been obvious to one having ordinary skill in the art at the time of the invention was made to

use a silyating agent as taught by Buchanan to deposit a silicon precursor and form a metal silicide film, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice In re Leshin, 125 USPQ 416.

Regarding claim 29, Buchanan teach (Example 1 in cols. 18-19) the method above, wherein said nitrogen source is ammonia.

Regarding claim 30, Buchanan teach (col. 5/lls. 43-67) the method above, wherein said metal source is selected from the group consisting of: a) a dialkylamino; and/or b) alkoxy ligands.

Regarding claim 32, Buchanan teach (Examples 3 and 4 in col. 19-21) the method above, wherein the amounts of said metal source and said silicon source in said desired final composition of said dielectric film are controlled independently (preferred amounts deposited using ALD in a cyclic fashion).

Regarding claim 34, Buchanan teach (Example 12 in cols. 23-24, col.24/ll.6-34), see also col.7/ll.30-51) the method above, wherein said dielectric film step is completed by using an atomic layer deposition process.

Regarding claim 38, Buchanan teach (Example 1 in cols. 18-19: silane, disilanes, chlorosilanes, silylamines) the method above, wherein said silicon source is selected from the group comprising: a) disiloxane; b) trisilylamine; c) disilylamine; d) silylamine; e) tridisilylamine; f) aminodisilylamine; g) tetrasilyldiamine; h) disilane; i) derivatives of disilane and/or trisilane; and j) mixtures thereof.

Regarding claim 41, Buchanan teach (Examples 3 and 4 in col. 19-21) the method above, wherein the amounts of said metal source and said silicon source in said desired final composition of said dielectric film are controlled independently (preferred amounts deposited using ALD in a cyclic fashion).

4. Claim 21, 25, 27-28, 37, and 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Colombo et al. (US 2003/0111678) in view of Buchanan et al. (US 6,984,591), and in further view of Oshita et al. (of record) (Hf_{1-x}Si_xO₂ deposition by metal organic chemical vapor deposition using the Hf(Net₂)₄/SiH(Net₂)₃/O₂ gas system).

Regarding claim 21, the combination of Colombo and Buchanan fails to teach a molecular structure absent carbon and/or a molecular structure absent chlorine.

However, Oshita teach (pg. 209, "2. Experiment", a metal silicon oxide formed by CVD and further pg. 211 also mentioned in Abstract, this process results in a metal silicon oxide film having no residual carbon) said silicon source comprises a molecular structure absent carbon.

Since Oshita in combination with Colombo and Buchanan fails to teach the method above, it would have been obvious to have a molecular structure absent carbon, as carbon acts as an impurity which increases leakage current thereby reducing the electrical properties of the resultant MSiO/MSiN/MSiON structure (pg. 208, "1. Introduction").

Regarding claim 25, Colombo teach (par. 24) said oxygen source comprises a molecular structure absent carbon and/or a molecular structure absent chlorine.

Regarding claim 27, Buchanan teach (e.g. figs. 1 and 4, Examples 11-12 in cols. 22-24) the method above, wherein said nitrogen source comprises a molecular structure absent carbon and/or a molecular structure absent chlorine.

Regarding claim 28, Buchanan teach (e.g. figs. 1 and 4, Examples 11-12 in cols. 22-24) the method above, wherein said nitrogen source is the same as said metal source or said silicon source.

Regarding claim 37, Buchanan teach (e.g. figs. 1 and 4, Examples 11-12 in cols. 22-24) the method above, wherein said silicon source comprises a molecular structure absent carbon and/or a molecular structure absent chlorine.

Regarding claim 39, Buchanan teach (e.g. figs. 1 and 4, Examples 11-12 in cols. 22-24, Example 1 in cols. 18-19, see also Abstract) the method above, wherein said oxygen source is the same as said metal source or said silicon source.

Response to Arguments

5. Applicant's arguments with respect to claim 19-21, 24-41 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

6. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to ARMAN KHOSRAVIANI whose telephone number is (571)272-2554. The examiner can normally be reached on Monday to Friday, 7:30a - 5:00p (Eastern Time).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Steven Loke can be reached on 571-272-1657. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

AK

/DAVID VU/

Primary Examiner, Art Unit 2818